Section 9. Quality Assessment Subsystem

9.1 Introduction

The Quality Assessment Subsystem (QAS) generates and assembles postproduction information about image artifacts and effects, and produces a summary of the processed image quality. The QAS performs QA after radiometric and geometric correction of images has been made. The QAS provides tools for analyzing images automatically, and manually, through visual inspection

9.2 Design Overview

This section provides an overview of the QAS software design. It presents the relationships between QAS and the other LPGS subsystems. It also discusses the assumptions, constraints, and considerations used in the design process.

9.2.1 Subsystem Software Overview

Figure 9–1 contains the QAS context diagram.

QAS receives Level 1 Quality Assessment requests from PCS. When notified that L1 processing and product formatting are completed, PCS provides processing parameters (Qas_Proc_Req) to QAS to initiate automated or manual quality assessments of L1 images and formatting. The QAS extracts the L1R and L1G characterization results for analysis from the Image_Processing_Files store and LPGS database. In addition to the image file and database, the QAS uses ancillary data from the ancillary data store, L0R_QC_Stats, and the calibration parameter file to determine whether the image contain artifacts or other effects that have not or could not be corrected. The QAS also provides information about thresholds applied during processing. If the image fails a threshold or a combination thresholds, the AAS is notified via the PCS. The QAS provides a summary of the quality of the image processing, Proc_Qual_Report, to the DMS.

9.2.2 Design Considerations

This section describes the design considerations used while developing the QA Subsystem. Where applicable, the QAS design approach was to reuse portions of the IAS Evaluation and Analysis (E&A) Subsystem.
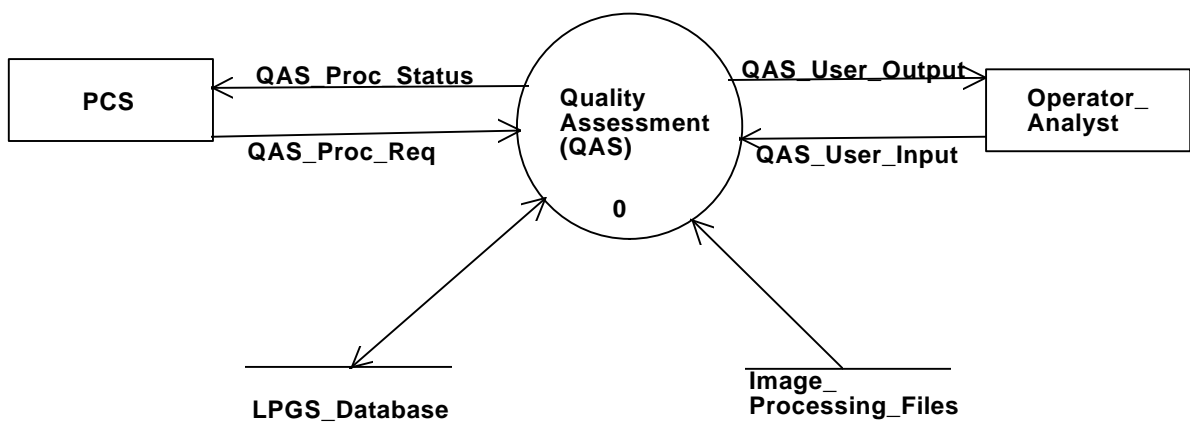
9.2.2.1 Design Assumptions

It is assumed that the proposed hardware and operating system will support Interactive Data Language (IDL), and the Environment for Visualizing Images (ENVI). It also is assumed that a COTS package such as FrameMaker will be used for reports.

9.2.2.2 Open Issues

There are no open issues.

```
                    QAS_Proc_Status                           QAS_User_Output
      ┌──────────┐ ◄──────────────    ╭──────────╮   ──────────────►  ┌──────────┐
      │          │                   │  Quality   │                    │          │
      │   PCS    │                   │ Assessment │                    │ Operator_│
      │          │ ──────────────►   │   (QAS)    │  ◄──────────────   │ Analyst  │
      └──────────┘   QAS_Proc_Req    │            │   QAS_User_Input   └──────────┘
                                     │     0      │
                                     ╰──────────╯
                          ↙                              ↖
                  ─────────────                    ─────────────
                                                   Image_
                  LPGS_Database                    Processing_Files
                  ─────────────                    ─────────────
```

Figure 9–1. QAS Context Diagram

9.2.2.3 Operational Support

The QAS software performs the following operations:

- ASCII and image file display

- Formatted dumps and hardcopy outputs of images

- Statistical analysis of the outputs from the radiometric and geometric correction and characterization processes

- Report generation

- Screen display of all plots/reports

9.2.2.4 Software Reuse Strategy

The subsystem software is composed almost exclusively of COTS products.

9.2.3 Subsystem Error Handling

TBD

9.3 Subsystem Design

The QAS subsystem is broken into 3 tasks: the L1R Quality Assessment (Q1R), the L1G Quality Assessment (Q1G), and the Quality Assessment User Interface (QUI). Q1R and Q1G run in automated mode, and QUI is interactive. The QAS DFD is shown in Figure 9–2.

The QAS consists primarily of an integrated set of COTS software packages: ENVI, IDL, and FrameMaker. ENVI provides the basic graphical user interface (GUI) required for viewing the image by the QAS or AAS analyst. The automated statistical analysis for image assessment will be provided by the IDL programming language. Where necessary, the C programming language will be used.

FrameMaker or an equivalent COTS package will be used to generate customized reports and ENVI menus will be used to launch the reports.

9.3.1 L1R Quality Assessment Task

9.3.1.1 Task Overview

The Level 1 Radiometric Quality Assessment task (Q1R) analyzes the results (reports, masks, characterizations, etc.) from the Level 1 Radiometric Correction and Characterization. The outputs from the Radiometric Algorithms are the data inputs for the automated Q1R analysis. A (TBD) combination of characterization and correction thresholds, and characteristic results will be the basis for the quality assessment given to the radiometrically corrected image.
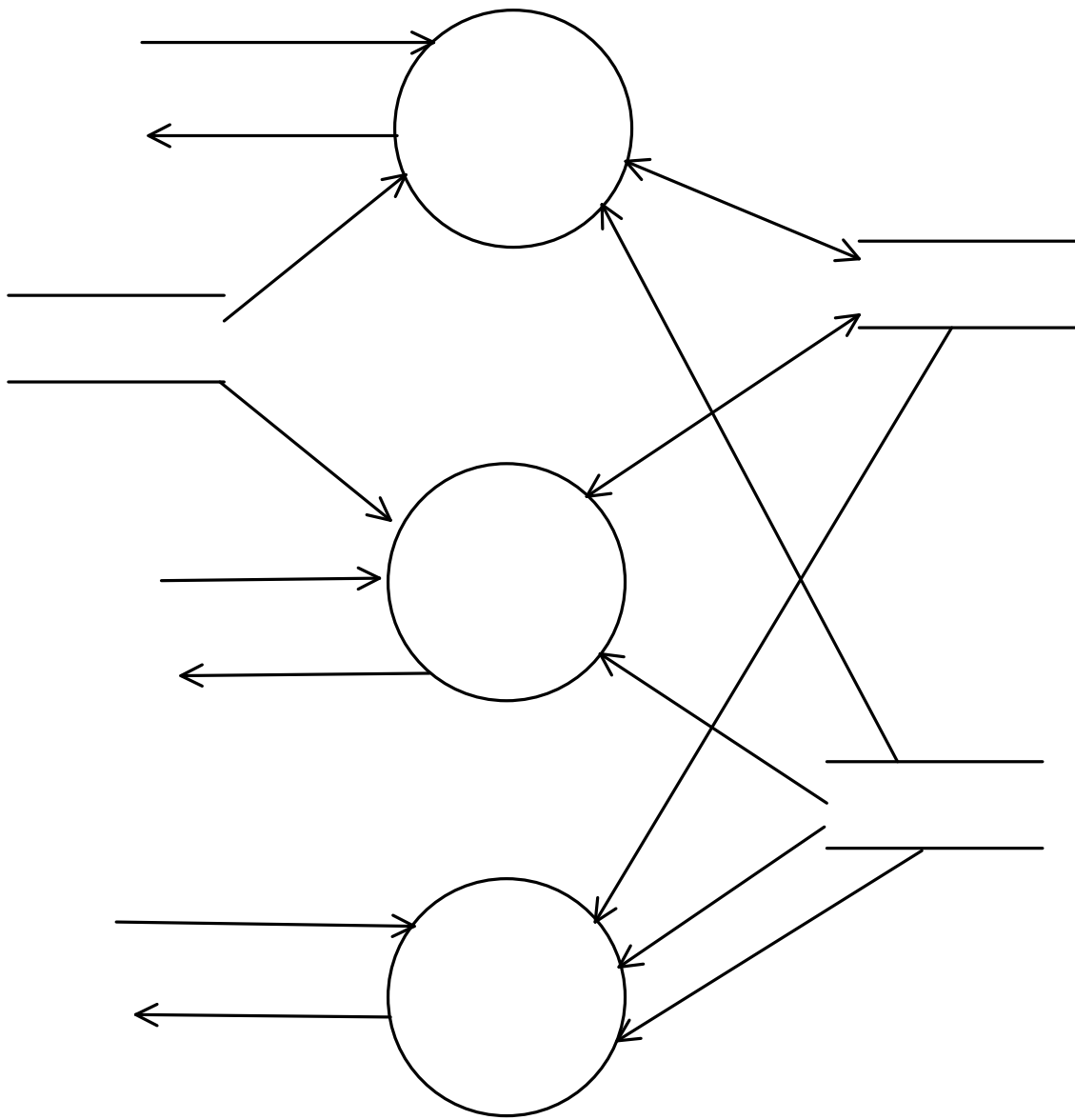
Figure 9–2. QAS Subsystem Architecture

9.3.1.2 Initialization

The Q1R task is started by the PCS Work Order Controller. It connects to the database and opens files to retrieve radiometric correction and characterization results.

9.3.1.3 Normal Operation

The PCS will invoke the Q1R task. PCS passes processing parameters and pointers associated with the WO to start Q1R processing. Following a successful initialization, the Q1R imports data from the L1R Image File and the LPGS Database. The outputs and basis for the Q1R analysis are from the Level 1 Radiometric Algorithms used in the Radiometric Characterization and Correction Process. All radiometric processing reports, masks, anomalies are analyzed. A combination or singular L1R threshold and/or characterization will determine the image's quality. If it is determined that the image has no anomalies (TBD), a successful Q1R assessment is assigned and image processing proceeds. If the image contains radiometric anomalies, the AAS is alerted and the image is passed to the AAS for further QA analysis. All interfaces to external subsystems is via the PCS. All results of the Q1R analysis are stored in the QAS Report fields.

9.3.1.4 Design

Figure 9–3 shows the structure chart for the L1R Quality Assessment task. Module specifications for Q1R are provided below.

NAME: q1r_main

TITLE: QAS Level 1 Radiometric Main

BODY: This module functions as the PCS message handler, and Q1R function initiator. The module begins by checking the LPGS Image File unique image address. If an error is detected then processing is halted and the fail status is returned to PCS. This module sequentially invokes the Q1R assessment functions.

NAME: q1r_init

TITLE: Q1R Initialization

BODY: This module initializes the Level 1 Radiometric Quality Assessment task by connecting to the database and image file. It returns a status flag or return code to indicate successful or unsuccessful completion.

NAME: q1r_read_1r_output

TITLE: Q1R Read of 1R Processing Output

BODY: This module reads the data stores from the L1R Image Characterization and Correction Algorithms.
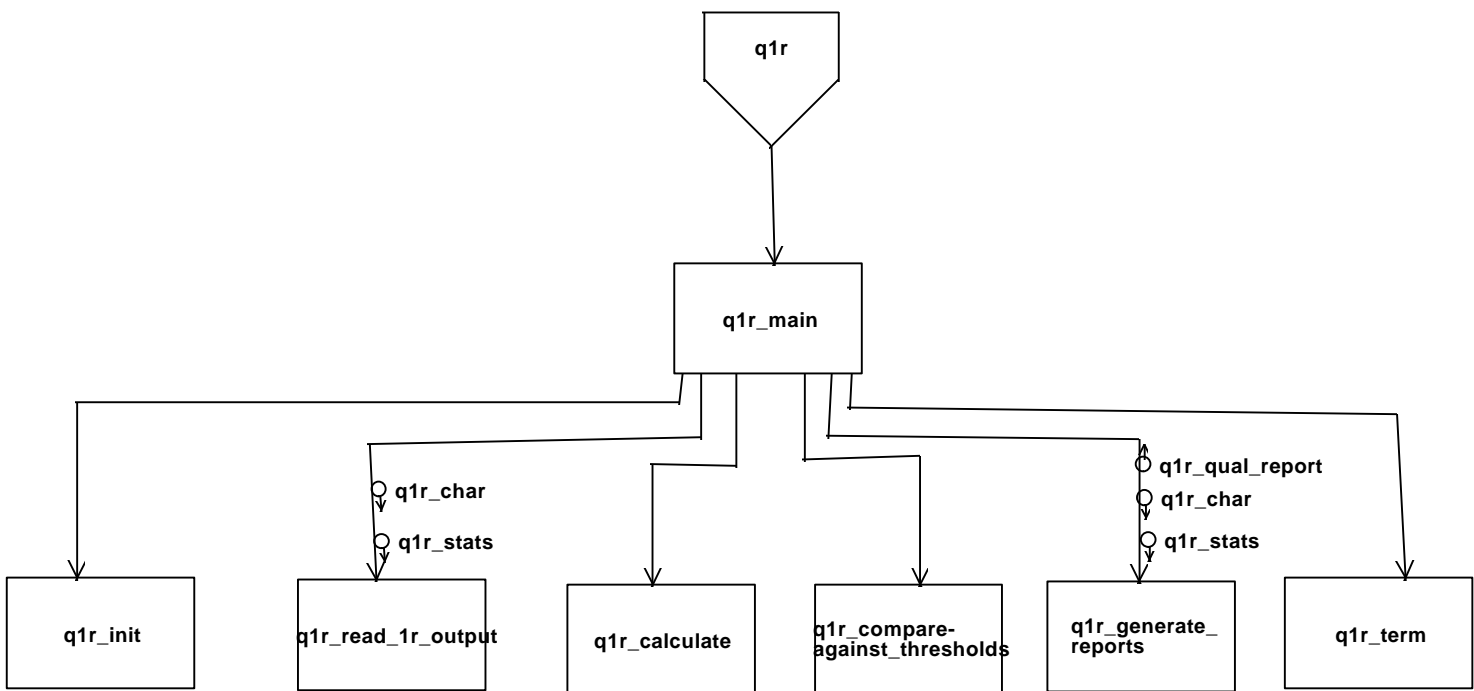
Figure 9–3. Q1R Structure Chart

TITLE: Q1R Calculate Image 1R Quality Rating

BODY: Algorithm data stores (reports, masks, errors) from radiometric correction and characterization process are read. The required combination of algorithm outputs and threshold values are processed. Based on this processing an image quality assessment is made. If any image anomalies are detected an alert AAS status flag is set. The results of this assessment are stored as data inputs to the Quality Report.

NAME: q1r_compare_against_thresholds

TITLE: Q1R Threshold Comparison

BODY: This module reads the stored threshold values and parameters input by the LPGS Analyst and compares the threshold to the outputs or data stores from the L1 Radiometric Process. The results of this compare are stored as data inputs to the Quality Report.

NAME: q1R_generate_rpts

TITLE: Generate QAS Reports

BODY: Oracle Reports and FrameMaker are the planned COTS packages for generating the Quality Report.

NAME: q1r_terminate

TITLE: Q1R Termination

BODY: This module disconnects from the database. It returns status to indicate successful or unsuccessful completion.

9.3.2 L1G Quality Assessment Task

9.3.2.1 Task Overview

The Level 1 Geometric Quality Assessment task (Q1G) analyzes the results from the Level 1 Geometric Correction. The outputs from the Geometric Algorithms are the data inputs for the automated Q1G analysis. A yet to-be-determined (TBD) combination of correction thresholds will serve as the basis for the quality assessment given to the geometrically corrected image.

9.3.2.2 Initialization

The Q1G task is started by the PCS Work Order Controller and connects to the database, image file, and ancillary data file to retrieve geometric correction results.

9.3.2.3 Normal Operation

The PCS will invoke the Q1G task. PCS passes processing parameters and pointers associated with the WO to start Q1G processing. Following a successful initialization, the Q1G imports data from the L1R Image File and the LPGS Database. The outputs and basis for the Q1G analysis are from the Level 1 Geometric Algorithms used in the Geometric Correction Process. All Geometric processing reports, masks, anomalies are analyzed. A combination or singular L1G threshold and/or characterization will determine the image's quality. If it is

determined that the image has no anomalies (TBD) a successful Q1G assessment is assigned and image processing proceeds. If the image contains geometric anomalies, the AAS is alerted and the image is passed to the AAS for further QA analysis. All interfaces to external subsystems is via the PCS. All results of the Q1G analysis are stored in the QAS Report fields.

9.3.2.4 Design

Figure 9–4 shows the structure chart for the L1G Quality Assessment task. Module specifications for Q1G are provided below.

NAME: q1g_main

TITLE: QAS Level 1 Geometric Main

BODY: This module functions as the PCS message handler, and Q1G function initiator. The module begins by checking the LPGS Image File unique image address. If an error is detected then processing is halted and the fail status is returned to PCS. This module sequentially invokes the Q1G assessment functions.

NAME: q1g_init

TITLE: Q1G Initialization

BODY: This module initializes the Level 1 Geometric Quality Assessment task by connecting to the database and image file. It returns a status flag or return code to indicate successful or unsuccessful completion.

NAME: q1g_read_1g_output

TITLE: Q1G Read of 1G Processing Output

BODY: This module reads the data stores from the L1G Image Correction Algorithms (MSCD, PCD, etc.).
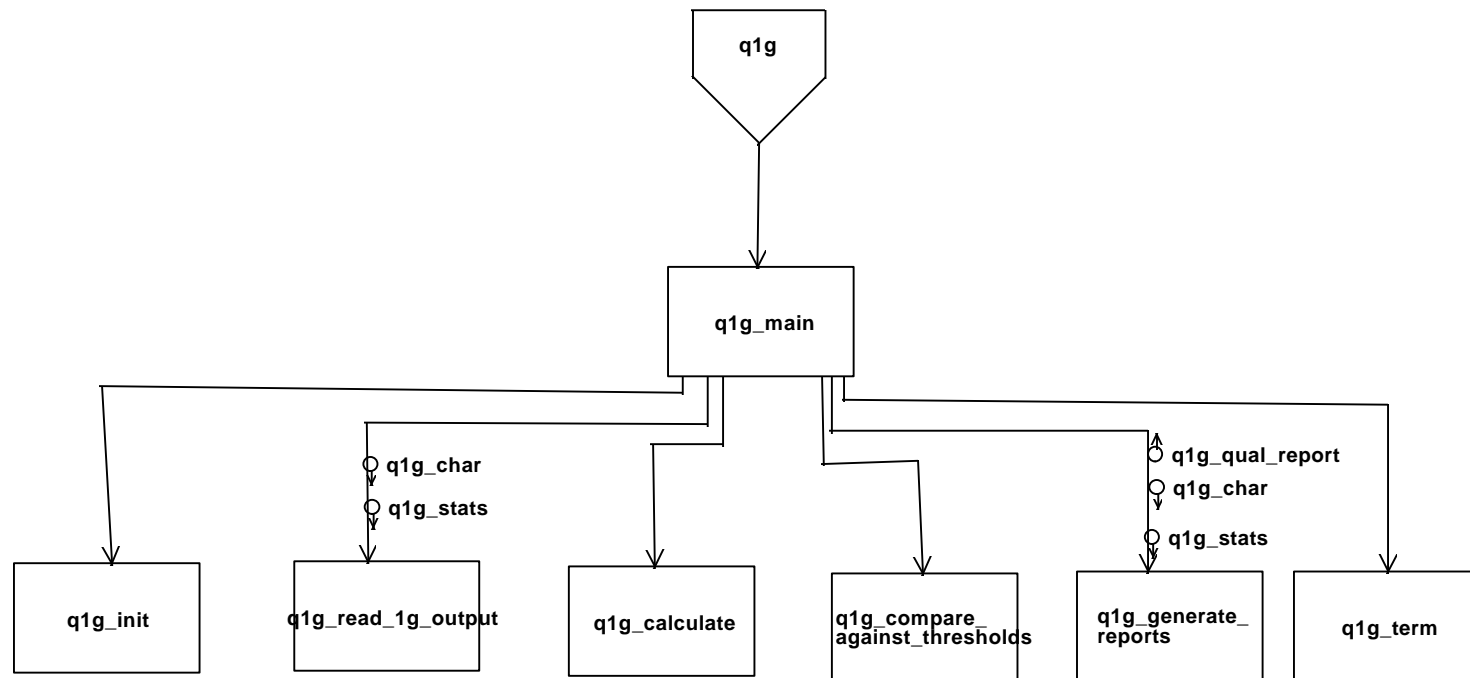
NAME: q1g_calculate

TITLE: Q1G Calculate Image 1G Quality Rating

BODY: Algorithm data stores from geometric process are read. The required combination of algorithm outputs and threshold values are processed. Based on this processing an image quality assessment is made. If any image anomalies are detected an alert AAS status flag is set. The results of this assessment are stored as data inputs to the Quality Report.

NAME: q1g_compare_against_thresholds

TITLE: Q1G Threshold Comparison

BODY: This module reads the stored threshold values and parameters input by the LPGS Analyst and compares the threshold to the outputs or data stores from the L1 Geometric Process. The results of this compare are stored as data inputs to the Quality Report.

q1g

q1g_main

q1g_char
q1g_stats

q1g_qual_report
q1g_char
q1g_stats

q1g_init

q1g_read_1g_output

q1g_calculate

q1g_compare_
against_thresholds

q1g_generate_
reports

q1g_term

Figure 9–4. Q1G Structure Chart

NAME: q1g_generate_rpts

TITLE: Generate QAS Reports

BODY: Oracle Reports and FrameMaker are the planned COTS packages for generating the Quality Report.

NAME: q1g_terminate

TITLE: Q1G Termination

BODY: This module disconnects from the database. It returns status to indicate successful or unsuccessful completion.

9.3.3 Quality Assessment User Interface Task

9.3.3.1 Task Overview

ENVI is a COTS package that provides the user interface for the LPGS Analyst. The QAS will write to Q1R and Q1G datasets, variables, and fields for subsequent retrieval by ENVI. Oracle Forms will generate the QAS Quality Report.
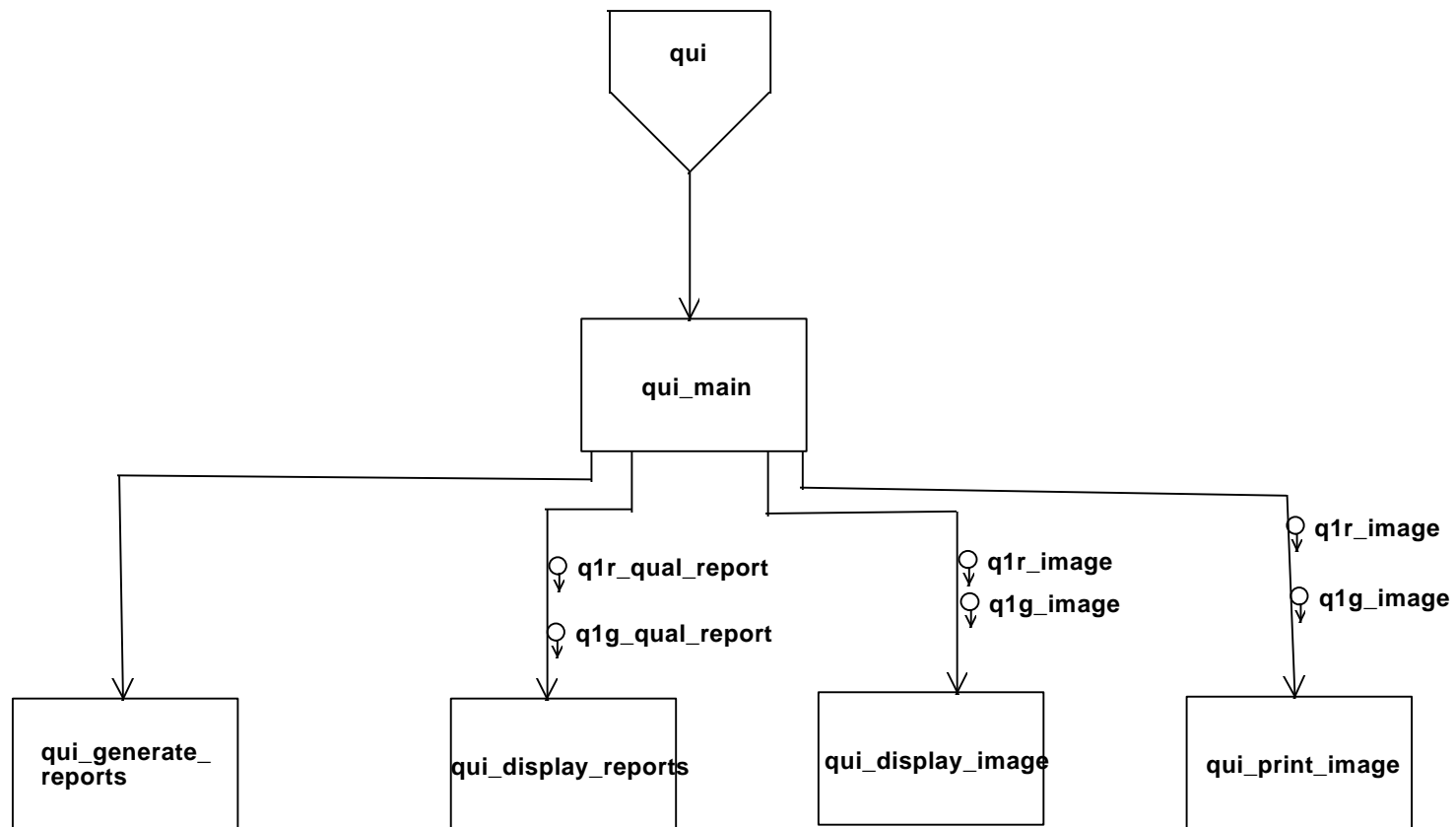
9.3.3.2 Initialization

TBD

9.3.3.3 Normal Operation

ENVI will normally be running at all times to provide the user interface for the LPGS Analyst. All functionality required by the Analyst will be accessed through the ENVI menu environment. This includes core ENVI functionality, custom IDL functionality, Oracle forms for database queries and Work Order submissions, FrameMaker for report generation, and simple text editors/viewers for viewing Work Orders pending, Run Log output, etc. The use of the ENVI interface is by nature highly interactive.

9.3.3.4 Design, Input, Output, Algorithm

ENVI is implemented in IDL and provides an extensive and customizable menu-driven interface to its functionality. The input, output, and algorithm used depend on the particular function chosen.

Figure 9–5 shows the structure chart for the QUI task.

qui

qui_main

q1r_image

q1r_qual_report

q1r_image

q1g_qual_report

q1g_image

q1g_image

qui_generate_
reports

qui_display_reports

qui_display_image

qui_print_image

Figure 9–5. QUI Structure Chart